Dec. 28, 1965 G. L. KULBICKI ET AL 3,225,493

THIN SECTION TRUEING MACHINE

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Fig. 1

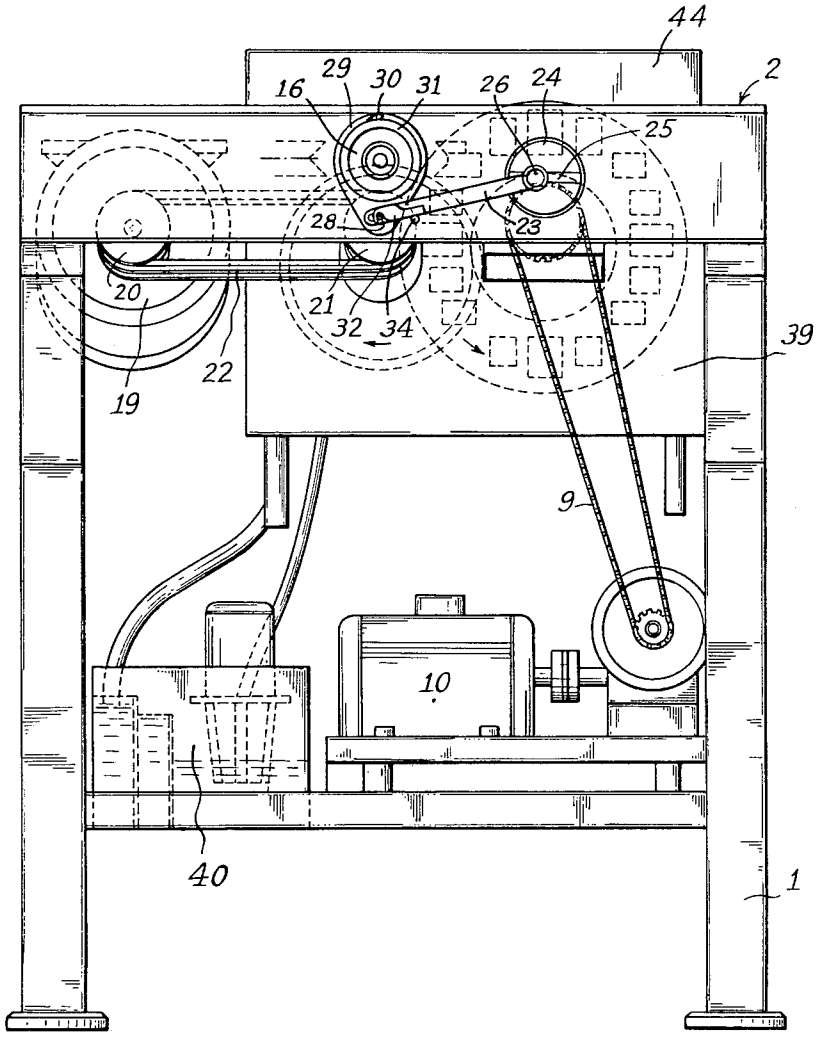

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Fig. 2

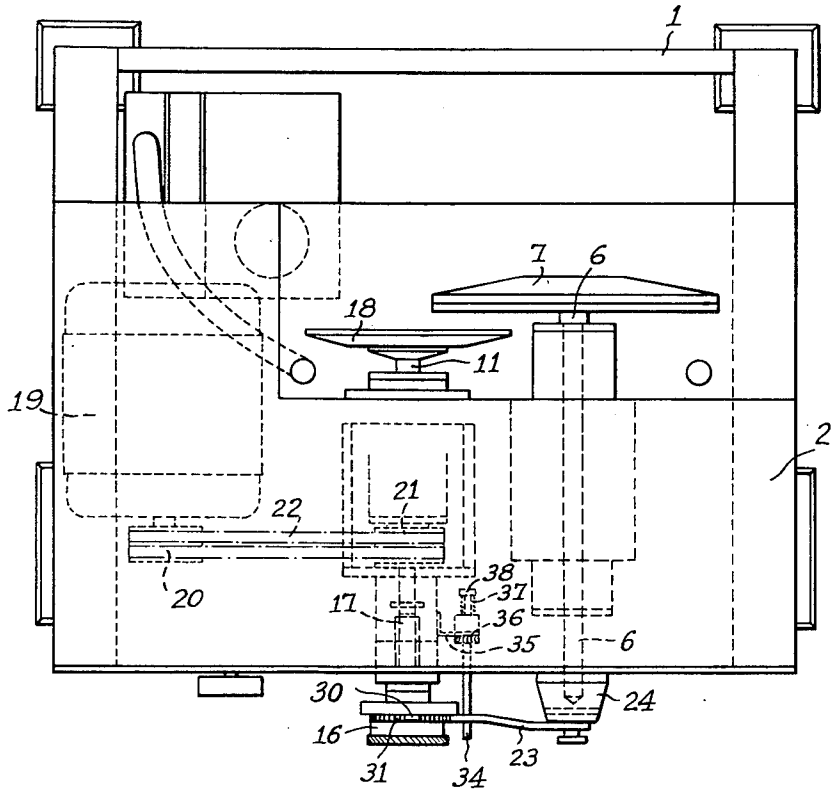

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Fig. 3

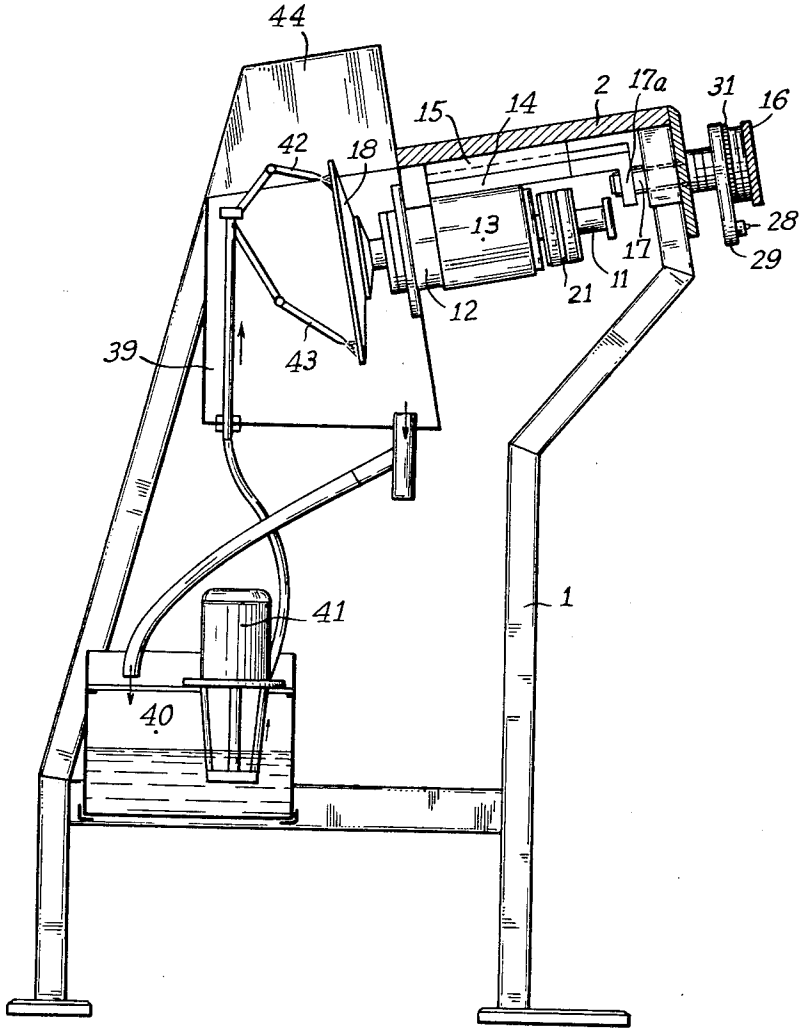

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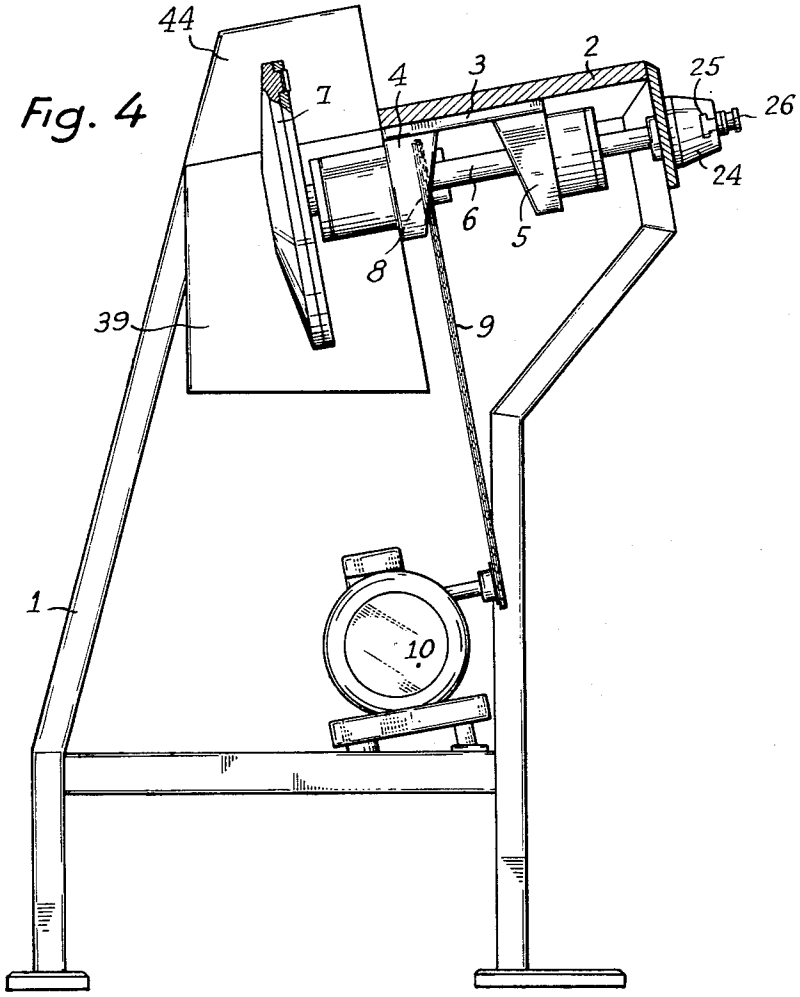
Fig. 4



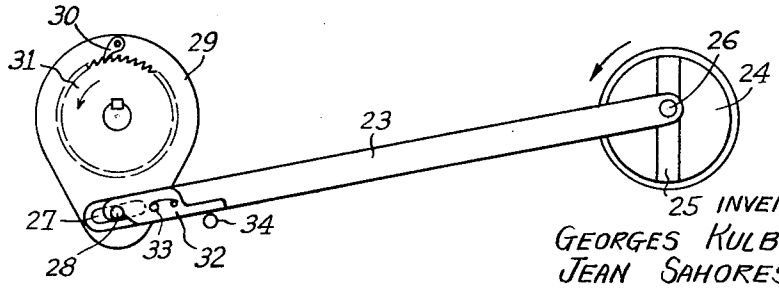


Fig. 5

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THIN SECTION TRUEING MACHINE

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3 Claims. (Cl. 51—134)

This invention relates to a thin section trueing machine.

For the microscopic study of solid bodies such as rocks, samples have to be made in the form of thin sections a few hundredths of a millimetre thick. The conventional procedure for the production of such specimens is to rough cut the rock samples with a suitable saw, stick the rough specimen on a glass plate and then finish it by hand with a grindstone and lapidary's mill. The manual work is slow, laborious and inaccurate. It is an object of the present invention to provide a machine which is capable of effecting rapidly, accurately and automatically the various thin section trueing operations which were previously carried out by hand.

To this end, the machine according to the invention comprises a frame, the top of which is provided with a bearer plate which is preferably slightly inclined to the horizontal and to which the mechanical parts of the machine are secured; these parts comprise firstly a section-holder system consisting of a rotating section-holder plate disposed at the end of a shaft rotated by a motor, and secondly a grindstone holder system consisting of a shaft disposed in parallel relationship to the section-holder system shaft and bearing the grindstone at the end; this shaft is rotated by a second motor and is also so mounted as to be displaceable axially by a vernier controlling a nut and screw system acting on the said shaft to bring the grindstone away from or up to the section-holder plate; the machine also comprises an automatic feed and stop for the grindstone and a spraying system for the latter.

In a preferred embodiment of the machine according to the invention, the automatic grindstone feed and stop system comprises a connecting rod and crank system associated with the free end of the section-holder system shaft, the free end of the connecting rod controlling a rocking lever which acts through the agency of a pawl borne by said rocking lever on a ratchet rigidly connected to the grindstone holder system shaft control vernier.

The rotation of the section-holder system shaft is thus converted by the connecting rod and crank system into a reciprocating movement transmitted to the rocking lever; this movement takes the form of a rotation by a fraction of a revolution on each oscillation of the connecting rod because the ratchet is driven in only one direction as a result of the shape of the teeth of this ratchet; the grindstone is thus gradually brought up to the section-holder plate.

The connecting rod and crank system preferably comprises a crank plate rigidly connected to the free end of the shaft of the section-holder system and formed with a diametric slot in which a pivot is adjustably locked, the connecting rod being articulated on said pivot.

The end of the connecting rod connected to the rocking lever is advantageously formed with an aperture in which engages a stud rigidly connected to the said rocking lever, said aperture being of a length such that the connecting rod does not drive the rocking lever when thestud slides in the said aperture; a hook-shaped stud locking element is articulated on this end of the connecting rod and is held in the locking position by a movable stop finger which is laterally displaced by the grindstone holder system to connect the stud to the connecting rod and prevent it from sliding in the aperture; this locking element releases the connecting rod stud by a rocking movement as soon as the stop finger is retracted at the end of the grindstone feed movement.

In order that the invention may be more fully understood a preferred embodiment thereof will now be described, by way of example only, with reference to the accompanying drawings wherein:

FIGURE 1 is a side view of the trueing machine;

FIGURE 2 is a plan view of this machine;

FIGURE 3 is a detail view showing the grindstone holder system and the auxiliary elements;

FIGURE 4 is a detail view showing the section-holder system; and

FIGURE 5 is a diagram showing the principle of the automatic grindstone feed and stop system.

Referring more particularly to FIGURES 1 to 4 of the drawings, the thin section trueing machine consists essentially of a frame, mechanical elements and a spraying system.

The top part of the frame **1**, which is made for example, from welded metal parts, has a bearer plate **2** to the underside of which the mechanical parts of the machine are screwed; the bearer plate is inclined about 10° to the horizontal. This arrangement enables the thin section supporting plate, which will be described hereinafter, to be inclined about 10° to the vertical. This improves the adhesion of the thin sections to the supporting plate, gravity no longer acting tangentially on these sections.

The mechanical elements comprise essentially: a section-holder system, a grindstone-holder system, a grindstone driving motor, and an automatic grindstone feed and stop system.

The section-holder system (FIGURE 4) comprises a support **3** fixed beneath the bearer plate **2** and having two bearings **4**, **5** exactly in line. These two bearings receive the drive shaft **6** for the section-holder plate **7** through two opposed taper roller bearings of any conventional type, not shown, to eliminate axial play of the shaft in the bearings. The plate **7** is fixedly mounted at the end of the shaft **6**, for rotation therewith. A sprocket wheel **8** is keyed on the shaft between the two bearings and by means of a chain **9** receives the rotation transmitted by a motor and reduction gear **10** secured to the bottom part of the frame **1**.

The grindstone-holder system (FIGURE 3) comprises a shaft or spindle **11** mounted in suitable bearings **12** to eliminate axial play of the shaft **11** therein. The support **13** for these bearings slides parallel to the shaft **6** in a conventional dovetail which includes a male guide **14** extending upwardly from the support **13**, fitted over a female guide **15** fixed to the underside of the bearer plate **2** and in strict parallel relationship to the shaft **6** for the section-holder plate **7**.

A grindstone **18** is fixedly mounted on the end of the shaft **11** for rotation therewith and can be moved away from or towards the section-holder plate **7** by means of a vernier **16** which controls a nut and screw system **17** connected with the male guide **14**. The latter has an extension **17***a* bored and tapped to threadably receive the screw **17**. Rotation of the screw **17** causes the extension **17***a* and the male guide **14** to reciprocate with the shaft **11** which is arranged in parallel relationship to the shaft **6**.

The grindstone **18** is rotated by a motor **19** fixed beneath the bearer plate **2**, through a transmission system comprising pulleys **20**, **21** and belts **22**. The grindstone driving pulley **21** is arranged to slide on the spindle **11**.

The automatic grindstone feed and stop system (FIGURE 5) comprises a connecting rod **23**, one end of which is connected to a crank plate **24** fixed on the shaft **6** for

driving the plate **7**. This crank plate is formed with a diametric slot **25** in which a pivot **26** is adjustably locked, the connecting rod being articulated on this pivot; movement of the pivot **26** in the slot **25** moves the end of the connecting rod away from the centre of the crank plate **24** to a greater or lesser extent which gives a varying amplitude of movement of the said connecting rod. At the other end, the connecting rod **23** is formed with an elongated aperture **27** in which engages a stud **28** fixed to a rocking lever **29** fitted over the screw **17** of the vernier **16**. A pawl **30** is provided at the top of the lever **29** and acts on a ratchet **31** connected to the vernier **16**.

A hook-shaped bolt **32** articulated at **33** on the connecting rod **23** is kept in the raised locking position by a stop finger **34** fixed to a lug **35** connected to the grindstone-holder system and advancing therewith. When the end of the finger **34** is retracted from beneath the bolt **32** at the end of the grindstone advance movement, the bolt rocks clockwise as viewed in FIG. 5 and frees the stud **28** which then slides freely in the elongated aperture **27** and the grindstone feed stops.

This automatic grindstone feed and stop system is therefore adjustable at two places: firstly, the amplitude of the movement of the connecting rod **23** can be adjusted, i.e., the number of teeth of the ratchet **31** driven on each oscillation of the lever **29** can be varied, by connecting the end of the connecting rod at a greater or lesser distance from the centre of the crank plate **24**; secondly, the final thickness of the sections is determined by varying the location of the end of the stop finger **34** by means of a knurled knob **36** screwed on the finger **34**. A return spring **37** acting on a shoulder **38** of this finger prevents any movement of the finger **34** with respect to the lug **35**.

The machine also comprises a spraying system (FIGURE 3).

Spraying plays an important part in the grinding of rock samples. It is also a vital factor in the life of the grindstone. It facilitates the work of the latter and contributes greatly to the finish of the thin sections.

Two systems may be provided for this purpose. A petroleum spraying system used for some rocks decomposed by water (for example clays) or a water spraying system. A system of the former type is shown in FIGURE 3 and comprises a recovery tank **39** provided beneath the grindstone **18** and a settling tank **40** provided at the bottom of the frame **1**. A pump **41** rests on the latter and delivers petroleum to the grindstone through two swivelling jets **42**, **43**. For a water spraying system, tap water is supplied to the same jets and is allowed to drain away. A hinge-mounted casing **44** protects the machine from being splashed with the spraying liquid.

The machine operates as follows: the rock samples are first rough-cut with a saw and then stuck to glass plates. These plates are disposed on the circular section-holder plate **7** where they are held simply by adhesion to the glass surface of the plate. Adhesion may be improved by grooving the central part of the housing of each plate; the recess thus formed behind the plate communicates through an aperture in the plate with a space in which a negative pressure is maintained, for example by a hard rubber bulb of a few cubic centimetres capacity fixed to the actual plate. The bulb is squeezed when the plate is put into position and is then released to create a partial vacuum behind the sample which is thus firmly held. The plates are held by a frame projecting slightly less than the thickness of the glass plates. The section-holder plate is rotated by a switch-controlled motor and reduction gear **10**.

The grindstone **18** is rotated by a switch controlled motor independent of the above-mentioned motor and moves axially. The thin sections face the grindstone. The latter is brought towards the sections by means of a vernier **16** to give a first contact with the rock samples. The operator then operates the automatic feed and stop system and then only has to watch the machine without intervening.

When the grindstone is at a distance of a few hundredths of a millimetre from the glass plates, the automatic feed and stop system stops and the grindstone feed ceases. The two switches are switched off and the sections are withdrawn ready to receive their cover glass or protective varnish.

A transparent material may be used for the bottom of the plate recess; and a source of focussed polarised light may be provided behind the section-holder plate. By means of a microscope in front of the plate (with the microscope objective extending perpendicularly to the sample), the colour of the sample can be assessed by transmitted light to determine whether the sample thickness is adequate.

We claim:

1. A grinding machine, comprising: a frame; a shaft rotatably mounted on said frame; a work-holder plate fixedly mounted on one end of said shaft and having a surface thereof for carrying the work facing toward said shaft; support means mounted on said frame for sliding movement parallel to said shaft; a grindstone spindle rotatably mounted on said support means for sliding therewith; an abrading member fixedly mounted on one end of said spindle with the abrading surface thereof facing away from said spindle and toward said surface of said plate for cooperation therewith; feed means for moving said support means toward and away from said plate; means for rotating said shaft; means for rotating said spindle; an adjustable crank fixedly mounted on said shaft for rotation therewith; a connecting rod secured at one end thereof to said crank; one-way drive means operably connected to said feed means for moving said support means toward said plate upon actuation thereof; means operably connecting the other end of said connecting rod to said one-way drive means for selectively actuating it and for movement relative thereto; said last named means including a lost motion connection between said other end of said connecting rod and said one-way drive means, a locking element mounted on said connecting rod for movement between a first position locking said connecting rod to said one-way drive means for simultaneous movement of said connecting rod and said drive means and a second position permitting relative movement between said connecting rod and said drive means; and stop means adjustably mounted on said support means and movable therewith, said stop means holding said locking element in said first position during a grinding operation and releasing said locking element to permit it to move to said second position at the end of a grinding operation.

2. A grinding machine, comprising: a frame, a shaft rotatably mounted on said frame and inclined at an acute angle to the horizontal with one end thereof at a lower elevation than the other end; a work-holder plate fixedly mounted on said one end of said shaft and having a surface thereof for carrying the work facing toward said shaft; support means mounted on said frame for sliding movement parallel to said shaft; a grindstone spindle rotatably mounted on said support means for sliding therewith; an abrading member fixedly mounted on one end of said spindle with the abrading surface thereof facing away from said spindle and toward said surface of said plate for cooperation therewith; feed means for moving said support means toward and away from said plate; means for rotating said shaft; and means for rotating said spindle, an adjustable crank fixedly mounted on said shaft for rotation therewith, a connecting rod secured at one end thereof to said crank; a rocking lever mounted on said feed means for rotative movement relative thereto; a one-way drive means operably connecting said lever and said feed means for moving said support means toward said plate upon rocking movement of said lever; means connecting the other end of said

connecting rod to said lever for selectively rocking said lever and for movement relative thereto; said last-named means including a lost motion connection between said other end of said connecting rod and said lever, a locking element mounted on said connecting rod for movement between a first position locking said lever to said connecting rod for simultaneous movement of said connecting rod and said lever and a second position permitting relative movement between said connecting rod and said lever; a stop finger adjustably mounted on said support means and movable therewith, said stop finger holding said locking element in said first position during a grinding operation and releasing said locking element to permit it to move to said second position at the end of a grinding operation.

3. A grinding machine, comprising: a frame; a shaft rotatably mounted on said frame; a work-holder plate fixedly mounted on one end of said shaft and having a flat surface thereof for carrying the work, said flat surface facing toward said shaft and oriented normally thereto; support means mounted on said frame for sliding movement parallel to said shaft; a spindle rotatably mounted on said support means so as to be parallel to the sliding movement of the latter and adapted to slide therewith; an abrading member fixedly mounted on one end of said spindle and having a flat abrading surface parallel to and facing toward said surface of said plate for cooperation therewith; feed means actuated by rotation of said shaft for sliding said support means for decreasing by step-wise movement the distance separating

the work-holder plate from the abrading member; means for rotating said shaft; means for rotating said spindle; and control means on said support means governed by the position of said support means for controlling said feed means during a grinding operation such that a given work piece is ground in steps down to a desired thickness at which the control means arrests the feed means.

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